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ABSTRACT

The Third International Math and Science Study (TIMSS) provides an opportunity to benchmark student achievement against world class standards and to examine the influences of curriculum, textbooks, and educational systems on student achievement. Findings indicate that U.S. students at the fourth grade above the international average in both math and science, but at the eighth grade they perform about average in science and below average in math. The issue examines some of the factors that are important in influencing students' achievement in math and science. Graphics and tables presenting some results of TIMSS comparing the status of U.S. students with students from other countries are included. (ASK)

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Achieving World Class Standards in Math and Science

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JUNE 1997

NATIONAL ALLIANCE OF BUSINESS

WORKFORCE ECONOMICS TRENDS

THE BUSINESS VOICE ON WORKFORCE DEVELOPMENT

Achieving World Class Standards in Math and Science

In this issue of *Workforce Economics Trends*, we examine information about math and science across a series of dimensions. Piecing the story together, we gain an important perspective on some of the factors that are important in influencing student achievement in math and science. Some of the news is encouraging. Some of the news is disappointing.

The Third International Math and Science Study (TIMSS) provides an opportunity to benchmark student achievement against world class standards and to examine the influence of curriculum, textbooks, and educational systems on student achievement. The challenge is to lift achievement of all students so they can compete in the new global economy with students from all over the world. The differences in the relative performance of U.S. students at the fourth and eighth grades presents both a challenge and an opportunity to understand the reasons behind the differences.

- Fourth and eighth grade students in the United States perform above the international average in science. In math, fourth grade students perform above the international average while eighth grade students perform below average.
- Fourth and eighth grade math and science scores based on the National Assessment of Educational Progress (NAEP) are increasing.
- An important finding of the TIMSS study is the critical importance of what goes on in the classroom in determining eighth grade student achievement. Curriculum content and assessment systems are important in explaining variations in student achievement.
- Science curriculum is more focused than math curriculum in the United States relative to other countries in both the fourth and eighth grade. This may, in part, explain the better performance of U.S. students in science compared to math in both grades.
- More students are taking more advanced and challenging courses over the last 12 years.
- Student perceptions and teacher qualifications may also be important in understanding student achievement. The share of math and science teachers that have a state license and a major in their primary teaching area is among the lowest of all types of teachers.

As communities across the U.S. work together to improve student performance, this information begins to provide a road map to some of the critical issues that schools, communities, and business must think about as they launch efforts to improve their schools and raise student achievement. The National Alliance of Business continues to support local efforts to improve student achievement and school performance. Working on a variety of projects and organizing the Business Coalition for Education Reform (BCER), the Alliance is committed to raising achievement for all students.

Workforce Economics Trends is a compilation prepared by the Alliance of research profiling our nation's current and future workforce. The information --- statistics, facts and demographics --- highlighted is intended to help advance efforts to build a quality workforce.

Alliance members receive *Workforce Economics Trends* six times per year, bimonthly. Further information and analysis about the state of the American workforce is provided through the Alliance's newsletters --- *WorkAmerica*, *Workforce Economics* and our faxed bulletin *Legislative Update*.

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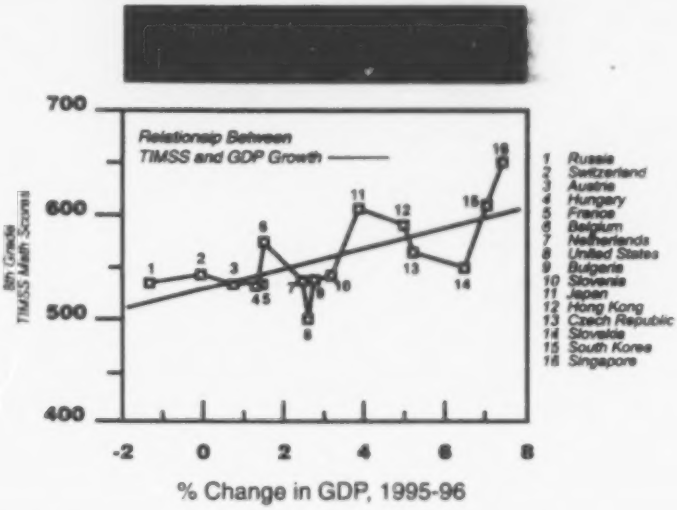
Students Excel in Math and Science in Countries with Higher Economic Growth

Countries where students do well in math and science tend to also achieve higher rates of economic growth as measured by Gross Domestic Product (GDP)



Source: Third International Mathematics and Science Study, November 1996 and International Monetary Fund.

Eighth Grade American Students Fall Below Many Nations in Math and Science Achievement

American students scored about average in science and below average in math according to the Third International Math and Science Study (TIMSS).

Eighth Grade Average TIMSS Score (Int Average = 500)

MATH

1	Singapore	643	11	Bulgaria	540	21	Israel	522	31	Spain	487
2	South Korea	607	12	Austria	539	22	Sweden	519	32	Iceland	487
3	Japan	605	13	France	538	23	Germany	509	33	Greece	484
4	Hong Kong	588	14	Hungary	537	24	New Zealand	508	34	Romania	482
5	Belgium (F*)	565	15	Russia	535	25	England	506	35	Lithuania	477
6	Czech Republic	564	16	Australia	530	26	Norway	503	36	Cyprus	474
7	Slovakia	547	17	Ireland	527	27	Denmark	502	37	Portugal	454
8	Switzerland	545	18	Canada	527	28	United States	500	38	Iran	428
9	Netherlands	541	19	Belgium(**)	526	29	Scotland	498	39	Kuwait	392
10	Slovenia	541	20	Thailand	522	30	Latvia	493	40	Columbia	385
									41	South Africa	354

SCIENCE

1	Singapore	607	11	Belgium (F*)	550	21	Tbaland	525	31	Romania	486
2	Czech Republic	574	12	Australia	545	22	New Zealand	525	32	Latvia	485
3	Japan	571	13	Slovakia	544	23	Israel	524	33	Portugal	480
4	South Korea	565	14	Russia	538	24	Hong Kong	522	34	Denmark	478
5	Bulgaria	565	15	Ireland	536	25	Switzerland	522	35	Lithuania	476
6	Netherlands	560	16	Sweden	535	26	Scotland	517	36	Belgium(**)	471
7	Slovenia	560	17	United States	534	27	Spain	517	37	Iran	470
8	Austria	545	18	Canada	531	28	France	498	38	Cyprus	463
9	Hungary	554	19	Germany	531	29	Greece	497	39	Kuwait	430
10	England	552	20	Norway	527	30	Iceland	494	40	Columbia	411
									41	South Africa	326

F* Flanders
** Wallonia

4

Source: Third International Mathematics and Science Study, November 1996.

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Fourth Grade Math and Science Achievement Is Better

In both math and science, U.S. students perform above the international average of the 26 countries participating in this part of TIMSS. In science, U.S. students were outperformed by students in only two countries--Korea and Japan.

Fourth Grade Average TIMSS Scores

MATH (Int. Avg.=529)

1	Singapore	625	11	Australia	546	21	Greece	492
2	Korea	611	12	United States	545	22	Thailand	490
3	Japan	597	13	Canada	532	23	Portugal	475
4	Hong Kong	587	14	Israel	531	24	Iceland	474
5	Netherlands	577	15	Latvia	525	25	Iran	429
6	Czech Republic	567	16	Scotland	520	26	Kuwait	400
7	Austria	559	17	England	513			
8	Slovenia	552	18	Cyprus	502			
9	Ireland	550	19	Norway	502			
10	Hungary	548	20	New Zealand	499			

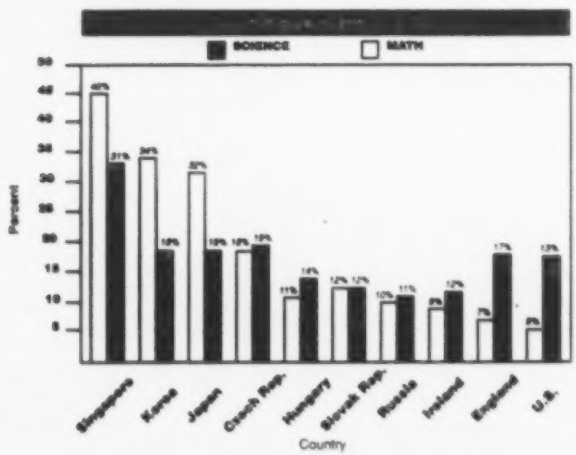
SCIENCE (Int. Avg.=524)

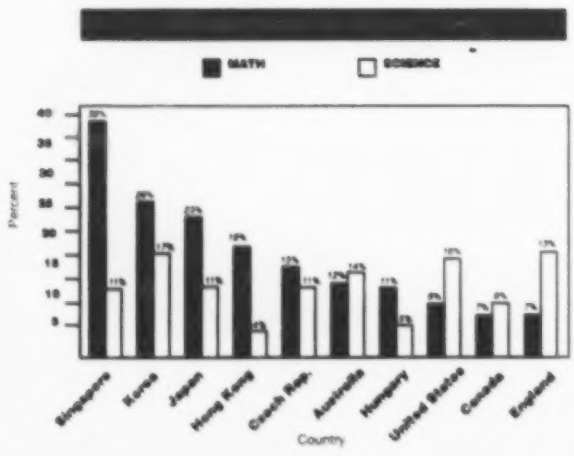
1	Korea	597	11	Slovenia	546	21	Greece	497
2	Japan	574	12	Ireland	539	22	Portugal	480
3	United States	565	13	Scotland	536	23	Cyprus	475
4	Austria	565	14	Hong Kong	533	24	Thailand	473
5	Australia	562	15	Hungary	532	25	Iran	416
6	Netherlands	557	16	New Zealand	531	26	Kuwait	401
7	Czech Republic	557	17	Norway	530			
8	England	551	18	Latvia	512			
9	Canada	549	19	Israel	505			
10	Singapore	547	20	Iceland	505			

Source: U.S. Department of Education, National Center for Education Statistics, Pursuing Excellence: A Study of U.S. Fourth-Grade Mathematics and Science Achievement In International Context, 1997.

Percentage of Eighth Grade and Fourth Grade Students Performing at the Top in Math and Science

Overall, U.S. students at both the fourth and eighth grade do better in science than in math. The portion of American 8th grade students that are among the top ten percent world-wide in math and science is considerably lower than the share of other nations. Singapore's share of the best students in eighth grade math is nine times greater than the U.S. In math, 9 percent of the U.S. 4th graders are among the world's top ten percent. In science, 16 percent of the U.S. 4th graders are among the world's top ten percent--no other country has significantly more of their students in the top percent.





Source: Third International Mathematics and Science Study, November 1996 and Pursuing Excellence.

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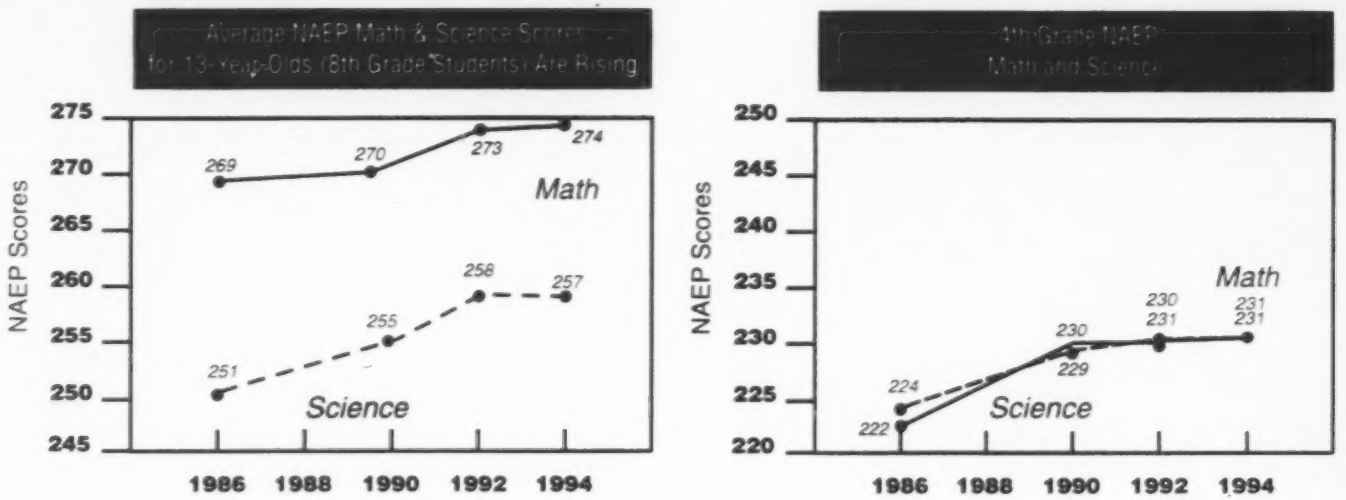
Student Achievement in Math and Science is Rising

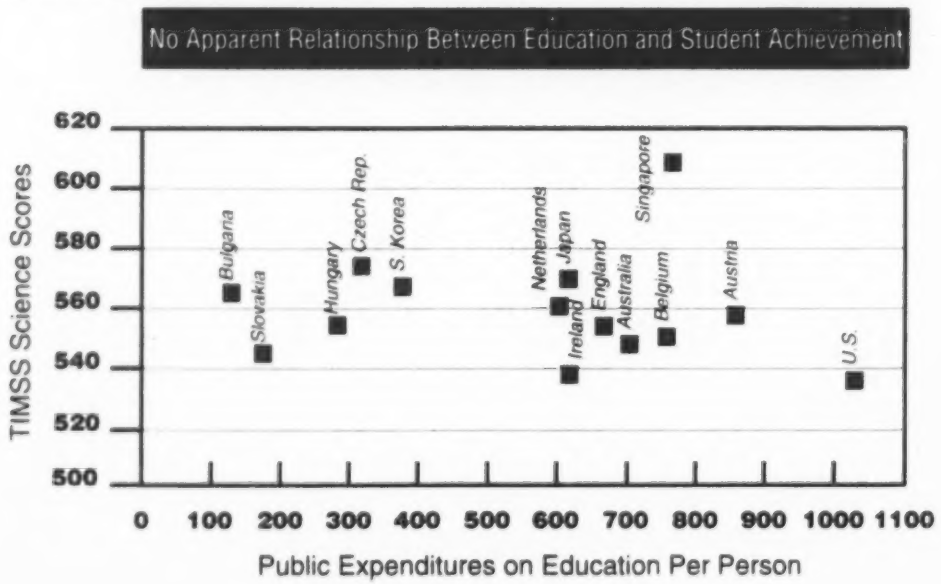
U.S. students in both fourth and eighth grade are doing better in math and science achievement over the last eight years. Despite our mediocre performance on the eighth grade TIMSS, we are making progress on improving eighth grade math and science performance at home.



Source: U.S. Department of Education, National Center for Education Statistics, The Condition of Education 1997

Many Nations Spending Less on Education, Score High in Student Achievement

There is no apparent relationship between school spending and student achievement. Countries that produce some of the highest achieving students often spend very little, while countries with higher per capita expenditures exhibit lower scores.



Source: Third International Mathematics and Science Study, November 1996.

When Comparing Curriculum ... Content Counts

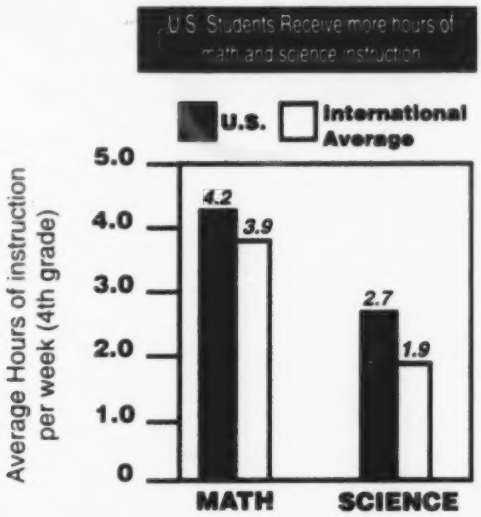
Differences in curriculum among countries may explain the difference in 8th grade TIMSS scores. The United States — whose basic content of 8th grade math includes arithmetic, fractions, and a small amount of algebra — is said to have a curriculum that is a mile wide and an inch deep. In Japan, where the curriculum is more narrow but substantive, the basic content for 13 year-old math students includes intense coverage of algebra and geometry.

- *U.S. 8th Grade Math classes are not as advanced or as focused as those in other countries.*
- *U.S. 8th Grade Math classes are at a 7th grade level by international standards*
- *U.S. Math classes require less high-level thought than classes in other countries.*

Source: Third International Mathematics and Science Study, November 1996.

Fourth-grade Students Receive More Hours of Instruction Compared to other Countries

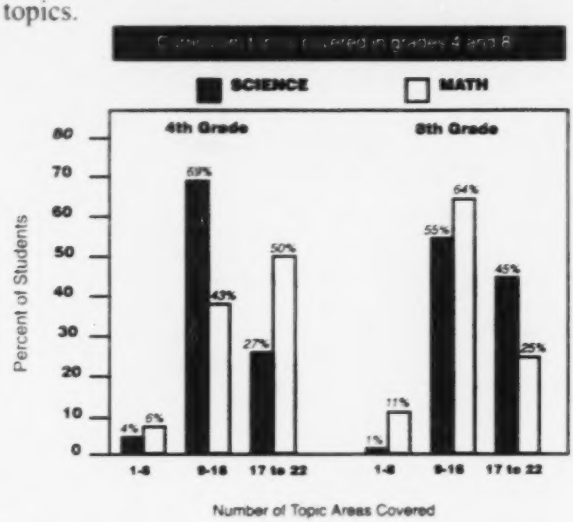
Fourth-grade students spend more hours receiving science and math instruction per week than the international average.



Source: U.S. Department of Education, National Center for Education Statistics, Pursuing Excellence: A Study of U.S. Fourth-Grade Mathematics and Science Achievement In International Context, 1997.

Math Curriculum is More Focused in the Fourth-grade Compared to Eighth Grade.

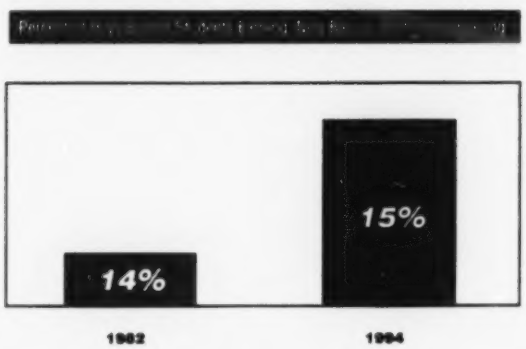
The curriculum in the U.S. is more focused in science than in math at both the fourth and eighth grade levels relative to other countries. When teachers report on what they actually teach, nearly 75 percent of the 4th grade teachers teach fewer than 17 math topics compared to 56 percent of 8th grade math teachers teaching fewer than 17 different topics.

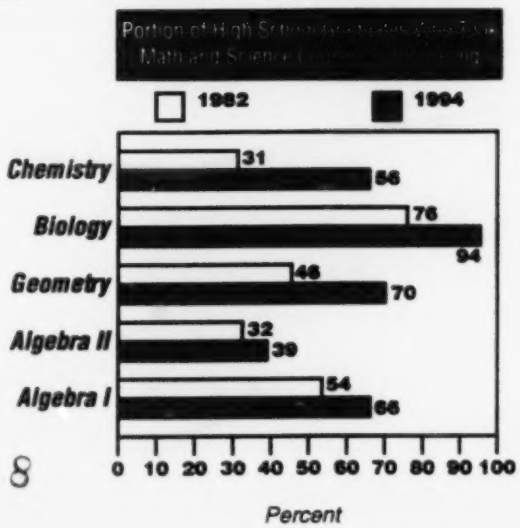


Source: U.S. Department of Education, National Center for Education Statistics, Pursuing Excellence: A Study of U.S. Fourth-Grade Mathematics and Science Achievement In International Context, 1997.

More Students Earning "New Basics" Curriculum and Taking Math and Science Classes

The portion of high school graduates earning the "New Basics" curriculum (which includes 4 years of english and 3 years of math, science and social studies) has tripled over the past 12 years. In addition, the number of students taking various math and science courses has also increased.





Source: U.S. Department of Education, National Center for Education Statistics, The Condition of Education 1997

Students Place Less Emphasis on Importance of Science and Advanced Math

A small share of high school students believes that science and advanced math are "extremely important" to learn prior to completing high school compared to other subjects.

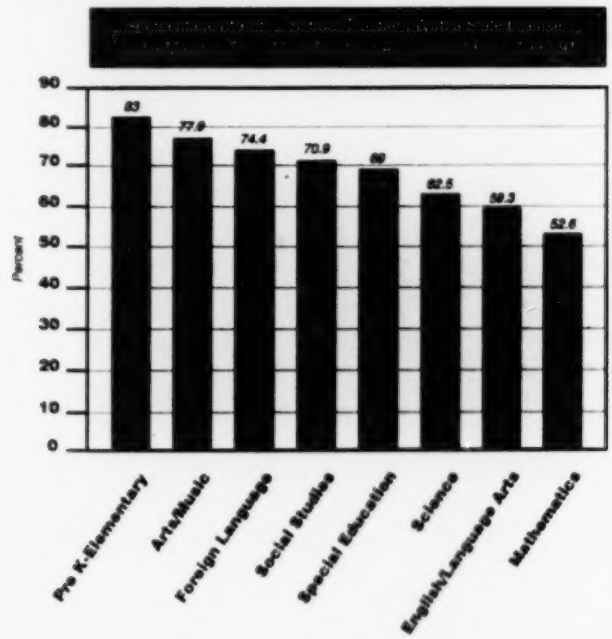
High School Students State Math and Science is Extremely Important to Learn in High School

Subjects	*All Students*	*White*	*African American*	*Hispanic*
Basic reading, writing and math	**94%**	**94%**	**96%**	**90%**
Biology, Chemistry, Physics	**44%**	**39%**	**62%**	**40%**
Advanced math: Calculus	**41%**	**34%**	**57%**	**46%**

Source: Public Agenda Foundation, Getting By: What American Teenagers Really Think About Their Schools, 1996

Fewer Teachers Possess Math and Science Qualifications Than in Other Disciplines

The percentage of math and science teachers with a state license and a major in their teaching assignment is among the lowest of all types of teachers.



Source: National Commission on Teaching & America's Future, What Matters Most: Teaching for America's Future, 1996

Students Learn More From Teachers Who Know Their Subject Matter

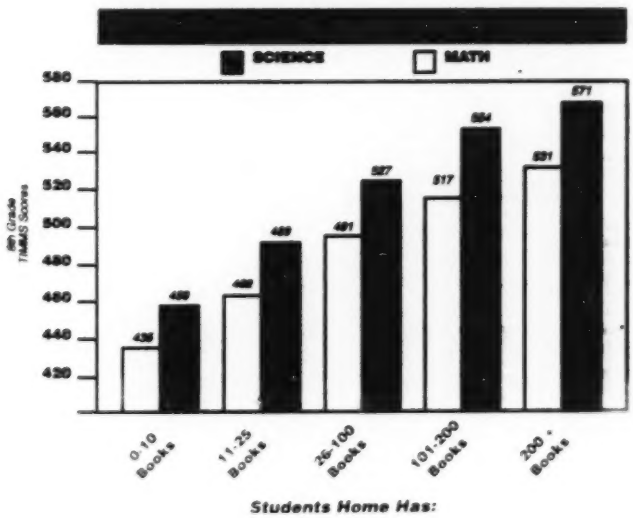
Students support higher standards and assessments. More than seven in ten say they would learn more if standards were raised and consistently enforced.

Seventy-one percent of high school students believe that a teacher who knows a lot about the subject they teach will let them learn "more." However only 46 percent of the students reported that most of their teachers are knowledgeable in the subject they were teaching.

Source: Public Agenda Foundation Getting By: What American Teenagers Really Think About Their Schools, 1996

Students With More Books in the Home, Achieve Higher Scores in Math and Science

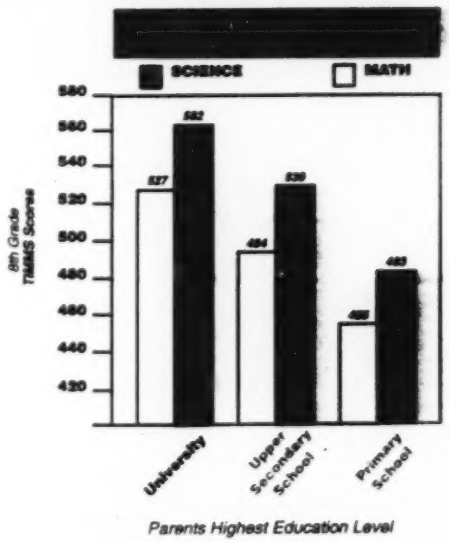
Students who reported that they had more books in their home had higher TIMSS scores than those with less books in the home.



Source: Third International Mathematics and Science Study, November 1996.

Education of Parents Affects Student Achievement

Children with parents who achieved higher levels of education do better in math and science than students whose parents achieved lower levels of education.



Source: Third International Mathematics and Science Study, November 1996.